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Injury Prevention Perspectives: Sports and Recreation Injury

Back Injury

Maj Bridget Carr

Mishap Prevention and Epidemiology
Branch

HQ Air Force Safety Center

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Overview

- Mishap Prevention and Epidemiology Branch
 - Mission, Function, Introduction
- Summary of select injury studies
 - Sports and recreation injury
 - Back injury
- Opportunities for follow-on studies

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Mission and Function

- Conduct safety and occupational health surveillance and research intended to minimize adverse impact to human and physical resources while enhancing mission efficiency and effectiveness.
- Health and Safety Promotion
- Mishap and Injury Prevention
- Data Integrity
- Partnerships
- Research and Cost-Benefit Analyses (CBAs)

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Team

- Lt Col Julie Robinson, BSN, MPH, COHN
- Maj Bridget K. Carr, DVM, MPH
- Maj Raymond E. King, Psy D
- Maj Maggie Meigs, Ph.D (Reservist)
- Ms DJ Atkins
- Mr Tom Schultz

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Intro to AFSC Database

- 'Best kept secret in the world'
- Reportable events per AFI 91-204 (DoDI 6055.7)
- Powerful Capabilities:
 - Population-based studies
 - Query by activity, anatomy, functional area...
 - Unlike anything else in the world
- Massive Oracle relational data base
 - Converting to SAS front end
 - Several retrieval software packages

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Sports and Recreation Injuries

12 Year Historical Study (1988 – 1999)
Military Personnel

Sources:

AFSC Database (Injuries)

AFPC Database (Population)

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Overview: Unintentional injury

Fatal (1.9/10Kp-y)

- PMV operations
 - Bike, pedestrian
- Water
- Hike, rock climb
- ATV, dirt bike, 4x4, snowmobile
- Firearms, hunting
- 'Air' activities

Disabling

(0.8/10Kp-y)

- PMV operations
- Water
- ATV, 4x4, dirt bike
- Firearms, hunting
- Tackle football
- Snow ski / board
- Bicycling

(Source: AFSC; 1988 - 1999)

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Overview: Unintentional injury

- Severe injury: Recreation >> Sports
- Lost time* injuries: 24 minutes per person-yr
- Incidence of Sports and Rec injuries
 - ~ 0.2% of AF population reports an injury per year
 - 21-25 yrs of age at greater risk overall
 - By sport, experience is similar to published lit.

*AFSC: Not fatal nor permanently disabling

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Most Common Sports *

- | | |
|-----------------------|-----------|
| • Basketball injuries | 22.5 % of |
| • Softball | 15.0 % |
| • Football | 11.5 % |
| • Weight lifting | 4.2 % |
| • Volleyball | 4.1 % |
| • Bicycling | 3.8 % |
| • Snow skiing | 3.6 % |

* Out Of ~102 Activity Options Reported

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What is expected?

- Compare high school, college populations
 - Case definition differs
 - Extrapolate: ~ 5% per yr (AF: 0.2% AFSC reported)
 - Crude: 25-fold less than expected
 - Multiple bias adjustments: 15-fold less
 - (24 minutes) X (15) = 6 hours per person-yr
- Other populations: $\frac{1}{4}$ of sick leave (2.5dy) for injury
- 'Less' than other healthy / active / employed

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Risks (data, literature review):

- Youth
 - Higher exposure
 - Greater risk-taking behavior
- Increasing age
 - Given same activity or task
- Task, activity, sport
 - 'Close' team sports
 - Biomechanical stress



Risks (data, literature review):

- Individual characteristics
 - Conformation, build ('unstable' or 'weak' knees, ankles)
 - Lifetime prevalence for some things is high
 - Internal derangement of knee, inguinal hernia
 - Sports, exertion 'accelerates' inevitable for prone
 - Fitness level
 - Higher risk for 'starters' and 'improvers' (any age)
 - Higher risk *given activity*, with increasing age
 - Least risk with moderation, maintenance



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What is preventable ?

- In excess of expectation
- Aggressive, lax rule enforcement *
- No, or misuse of, safety equipment / procedures *
- Drastic change, in times of needed reduced incidence
 - Limit play time
 - Change rules
 - * Supervised, sanctioned – benefit of ‘referee’ *

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Injury Epidemiology: Basketball

INJURED PART (CT)

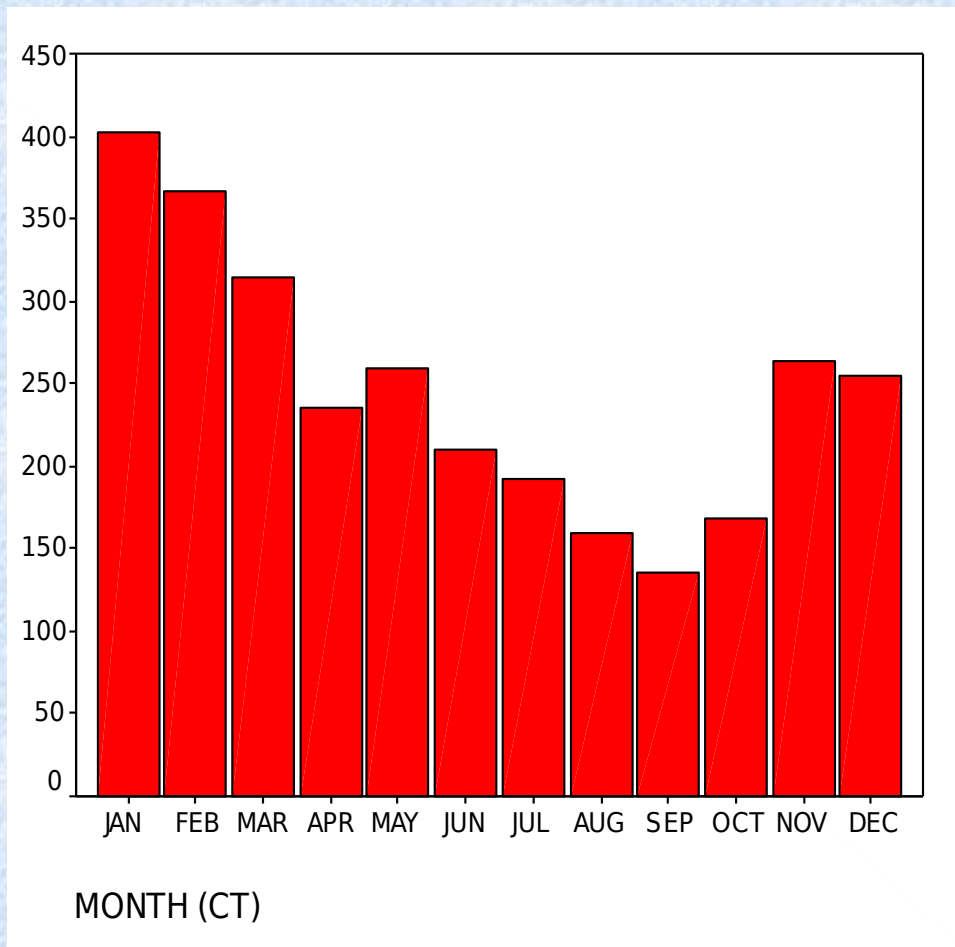
		Frequency	Percent
	FOOT, ANKLE	1289	43.5
	KNEE	601	20.3
	HEAD/NECK/SPINE/BACK	422	14.2
	FINGERS, THUMB, WRIST, HAND	188	6.3
	EAR, EYE, NOSE, JAW, MOUTH, TEETH, FACE	172	5.8
	BUTTOCKS, HIPS, PELVIS, UPPER & LOWER LEG	162	5.5
	ARM, FOREARM, ELBOW, SHOULDER	91	3.1
	INTERNAL & EXTERNAL CHEST, RIBS, GROIN, ABDOMEN	35	1.2
	Total	2960	99.9
	MISSING	2	.1
Total		2962	100.0

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Injury Epidemiology: Basketball

- Time lost
 - Mean: 5.5 days
 - Median: 2 days
 - Range: 1 - 88 days
 - 28% are hospitalized
 - Report bias
 - Mean: 3.5 days
 - Median: 1 day
 - Range: 1 - 61 days





Injury Epidemiology: Football

Tackle:

- Mean days lost: 7.8
- 52% are hospitalized
 - Mean: 4.2 days
- 2 permanent disability

Flag:

- Mean days lost: 5.8
- 35% are hospitalized
 - Mean: 3.8 days
- No disabling injury



Injury Epi: Tackle Football

- 1989 – 1998
 - 84% of mishaps associated with non-US installations
 - 75% of installations reporting were non-US
 - 4-fold decline in incidence by 1998, from 1989
 - Reason?



Injury Epi: Comparing sports

BASEBALL

	N	Minimum	Maximum	Sum	Mean
DAYS OF WORK LOST	83	1	36	556	6.70
DAYS HOSPITALIZED	33	1	20	120	3.64
Valid N (listwise)	33				

40 % Hospitalized

SOFTBALL

	N	Minimum	Maximum	Sum	Mean
DAYS OF WORK LOST	1975	1	56	11778	5.97
DAYS HOSPITALIZED	649	1	30	2349	3.62
Valid N (listwise)	649				

33 % Hospitalized

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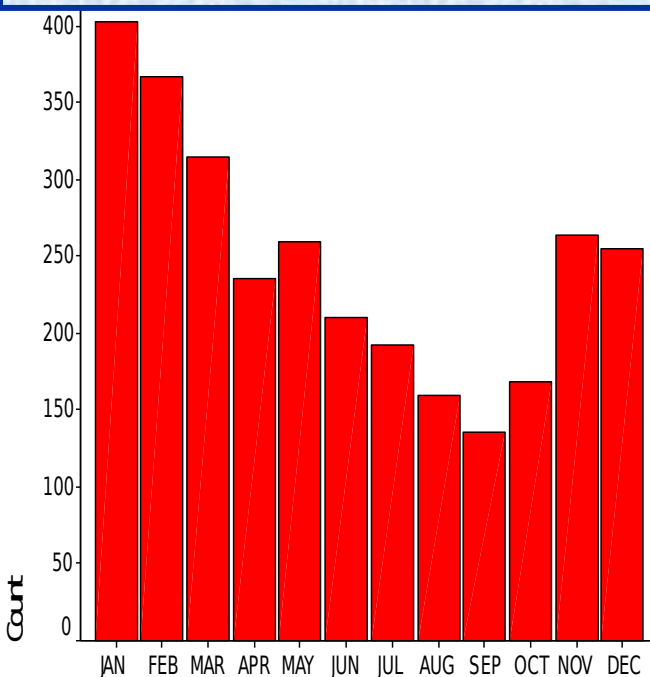


Injury Epi: Comparing sports

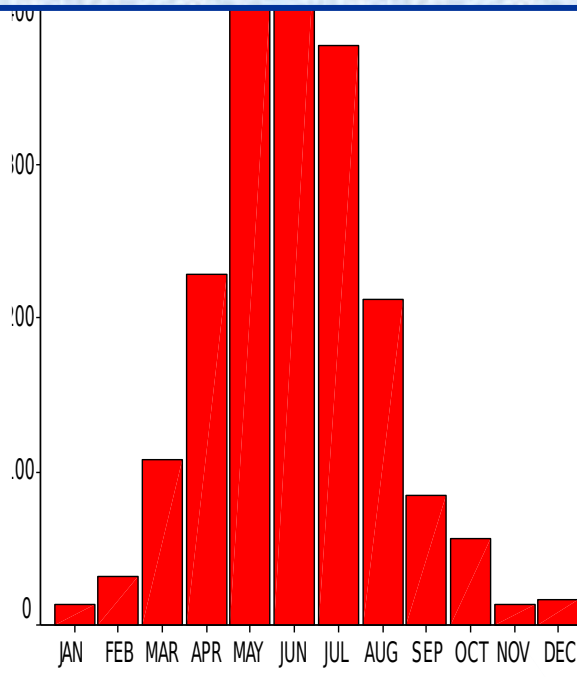
Basketball

Softball

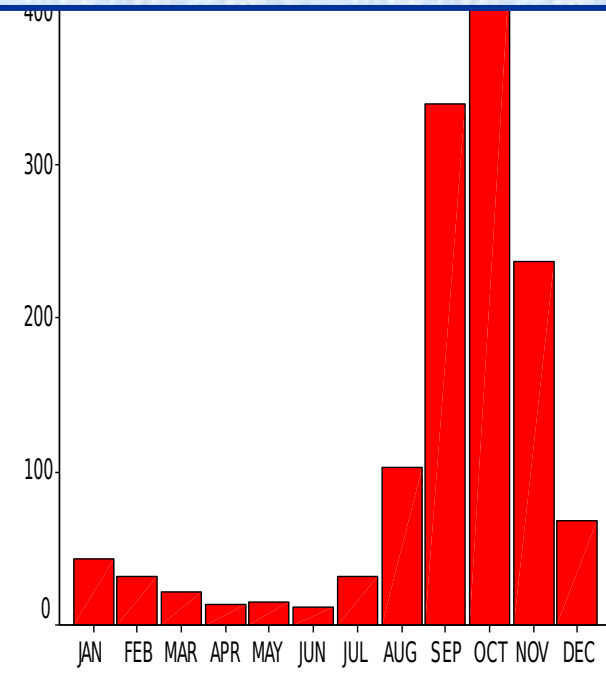
Football



MONTH (CT)



MONTH (CT)



MONTH (CT)

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Injury Epi: Comparing sports

- Risk per man-hour of play:

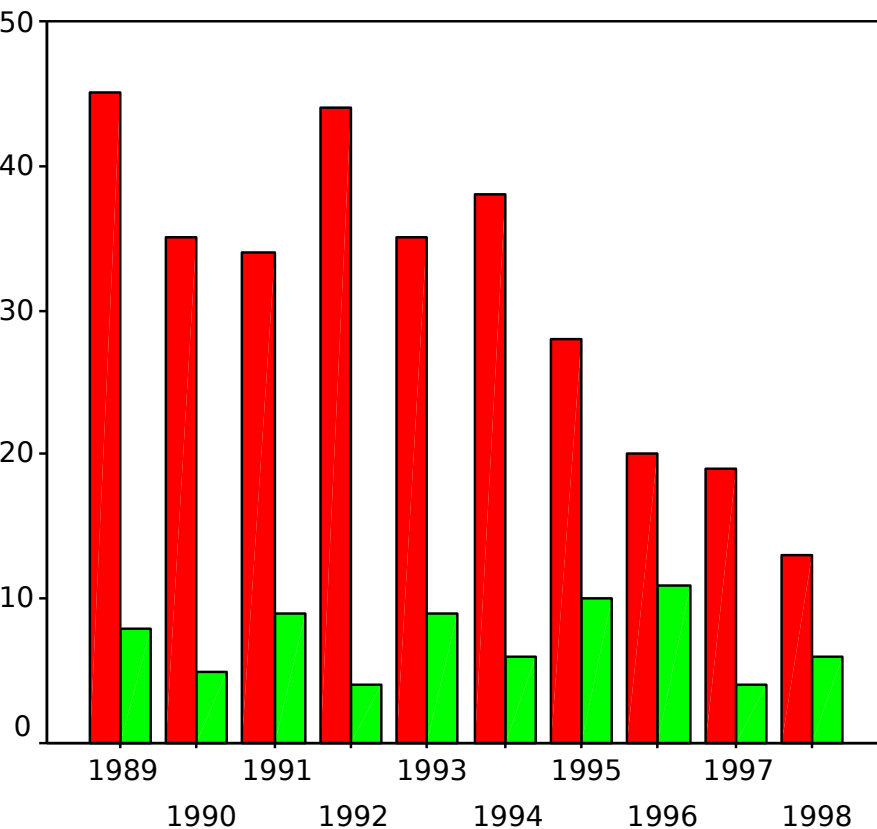
Softball $\sim$ = Flag Football $>$ Basketball

- Basketball # 1 by exposure (yr round, indoor)
- Softball # 2 by exposure (longer season)

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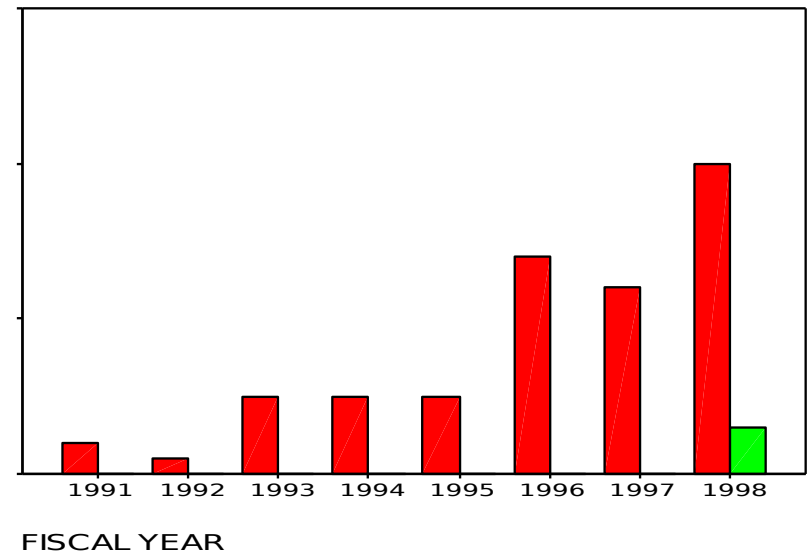
Injury Epi: Comparing sports



SEX (CT)

MALE

FEMALE



FISCAL YEAR

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Injury Epi: Comparing sports

Snow skiing:

	Frequency	Percent
KNEE	174	36.3
BUTTOCKS, HIPS, PELVIS, UPPER & LOWER LEG	88	18.4
ARM, FOREARM, ELBOW, SHOULDER	70	14.6
HEAD/NECK/SPINE/BACK	56	11.7
FINGERS, THUMB, WRIST, HAND	37	7.7
INTERNAL & EXTERNAL CHEST, RIBS, GROIN, ABDOMEN	24	5.0
FOOT, ANKLE	15	3.1
EAR, EYE, NOSE, JAW, MOUTH, TEETH, FACE	11	2.3
MULTIPLE OR OTHER	3	.6
Total	478	99.8
MISSING	1	.2
Total	479	100.0

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Injury Epi: Comparing sports

Snowboarding:

	Frequency	Percent
ARM, FOREARM, ELBOW, SHOULDER	21	★ 29.6
HEAD/NECK/SPINE/BACK	15	21.1
FINGERS, THUMB, WRIST, HAND	9	★ 12.7
FOOT, ANKLE	7	9.9
BUTTOCKS, HIPS, PELVIS, UPPER & LOWER LEG	7	9.9
INTERNAL & EXTERNAL CHEST, RIBS, GROIN, ABDOMEN	6	8.5
KNEE	3	4.2
EAR, EYE, NOSE, JAW, MOUTH, TEETH, FACE	2	2.8
MULTIPLE OR OTHER	1	1.4
Total	71	100.0

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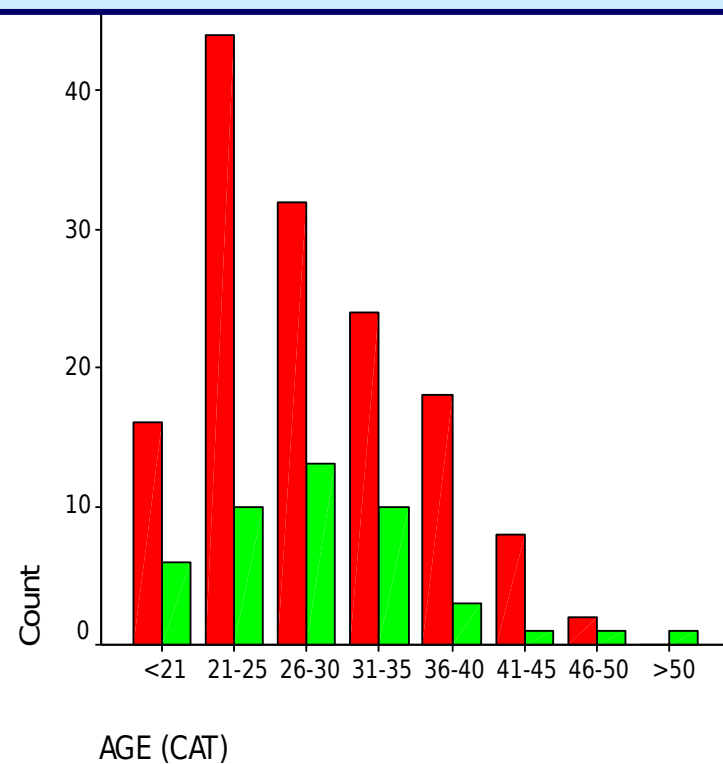
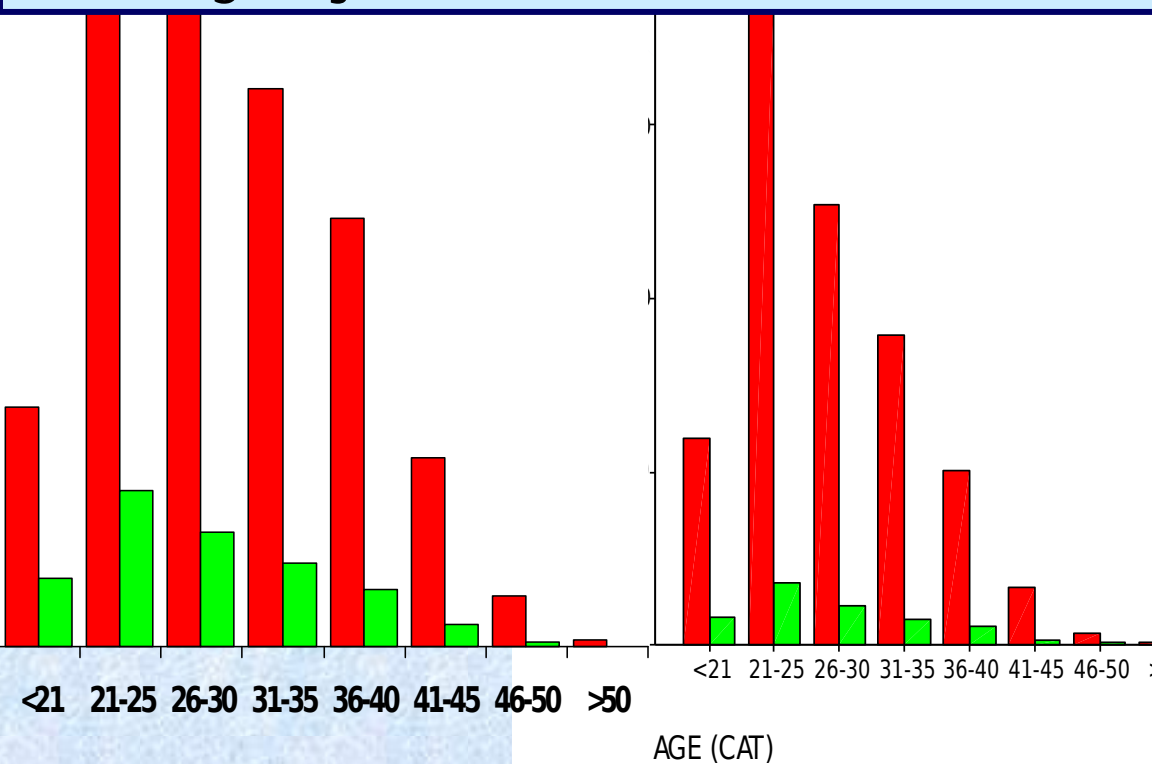


Injury Epi: Age, sex, distributions

Total force
ski injury

Sports & Rec inj

Snow



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Injury Epi: Water recreation

ACTIVITY		Frequency	Percent
WATER SKIING (INNER TUBE/AIR MATTRESS, ETC.)		149	26.5
SWMMING/WADING		131	23.3
BOATING	‘Alcohol involved’	69	12.3
FISHING		61	10.9
DIVING (NOT SCUBA)		45	8.0
SURFING (BODY/BOARD)		31	5.5
SKIN/SCUBA DIVING		27	4.8
RAFTING		11	2.0
WATER SLIDE		9	1.6
JET SKIING		7	1.2
SNORKELING		7	1.2
KNEE BOARD		3	.5
CROSSING RIVER BY CABLE		2	.4
PUSHED INTO WATER		2	.4
INNER TUBING		2	.4
PHOTOGRAPHY		1	.2
WATER SLIDE (HIT BY NEXT)		1	.2
DIVING (JUMP FROM BRIDGE INTO WATER)		1	.2
DIVING (JUMP FROM ROOF INTO POOL)		1	.2
WALKING ON JETTY		1	.2
'BREATH HOLDING CONTEST'		1	.2
Total		562	100.0



Injury Epi: Water recreation

FATAL EVENTS ACTIVITIES:		Frequency	Percent
SWIMMING/WADING		26	39.4
BOATING	★	13	19.7
SKIN/SCUBA DIVING		10	15.2
FISHING	★	5	7.6
DIVING (NOT SCUBA/SKY)		4	6.1
SNORKELING		3	4.5
RAFTING		2	3.0
PHOTOGRAPHY	★	1	1.5
CROSSING RIVER BY CABLE	★	1	1.5
WATER SKIING (INNER TUBE/AIR MATTRESS, ETC.)		1	1.5
Total		66	100.0

★ Never meant to get wet, but were near the water

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Injury Epidemiology: Hunting

Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean
DAYS OF WORK LOST	80	1	81	847	10.59
DAYS HOSPITALIZED	39	1	30	208	5.33
Valid N (listwise)	39				

50% hospitalized

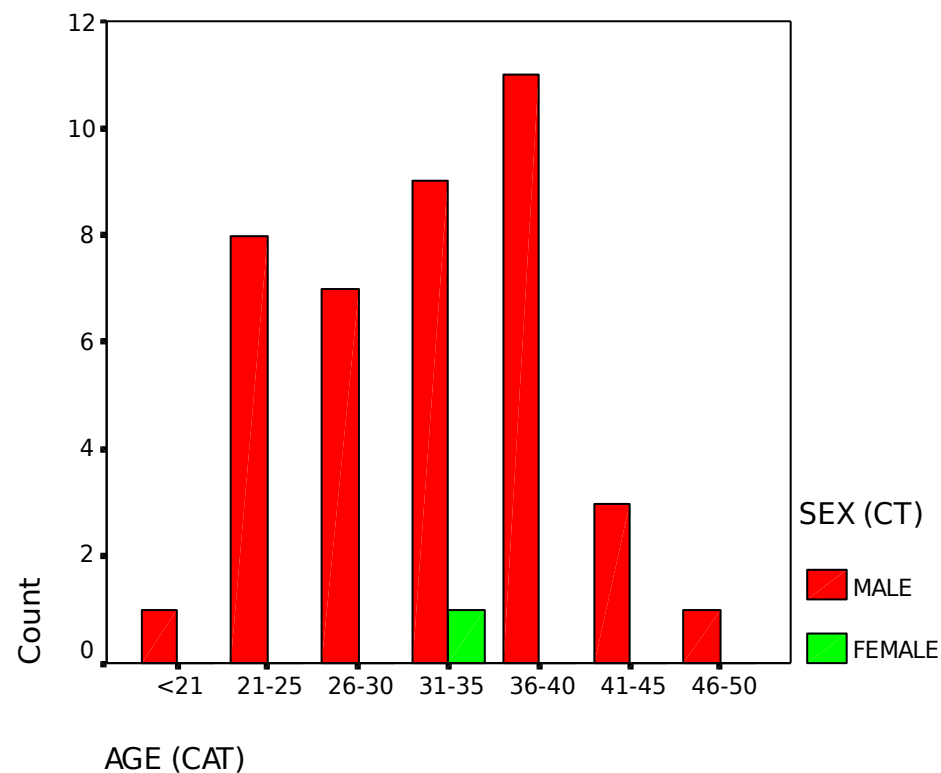
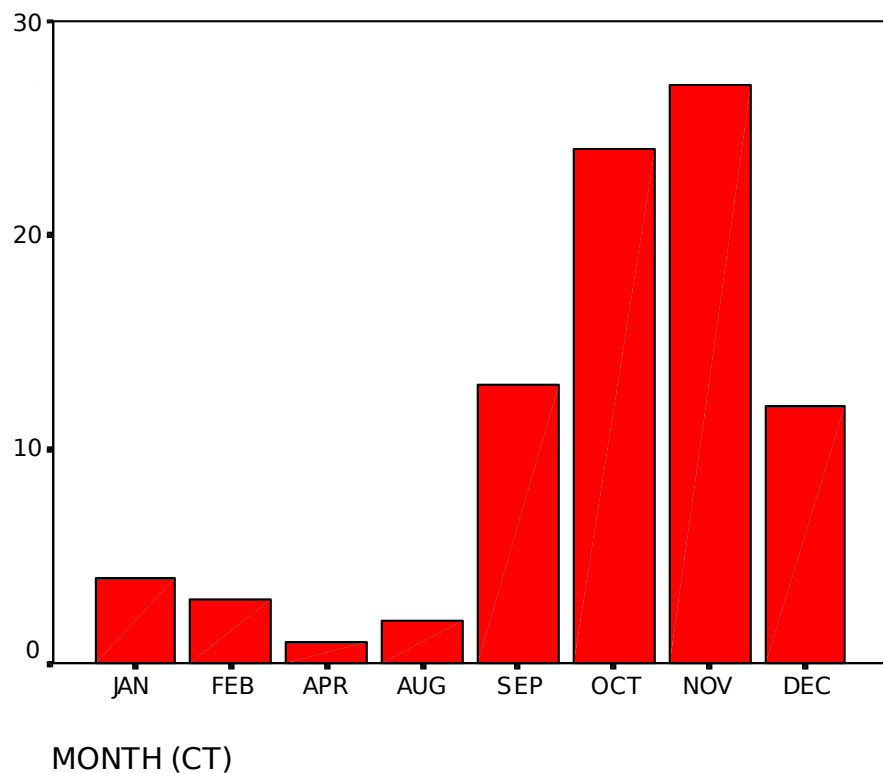
Fatal events 1989 - 1998 :

One hunter thrown from ATV, then crushed by it - it landed on him
Four others were killed by gunshot: 2 self inflicted, 2 by other party

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Injury Epidemiology: Hunting



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Injury Epidemiology: Hunting

INJURED PART (CT)

		Frequency	Percent
	HEAD/NECK/SPINE/BACK	31	36.0
	FOOT, ANKLE	15	17.4
	BUTTOCKS, HIPS, PELVIS, UPPER & LOWER LEG	12	14.0
	FINGERS, THUMB, WRIST, HAND	9	10.5
	INTERNAL & EXTERNAL CHEST, RIBS, GROIN, ABDOMEN	6	7.0
	ARM, FOREARM, ELBOW, SHOULDER	5	5.8
	EAR, EYE, NOSE, JAW, MOUTH, TEETH, FACE	5	5.8
	KNEE	2	2.3
	MULTIPLE OR OTHER	1	1.2
	Total	86	100.0

15 / 86 (17%) from 'ACCIDENTAL' GUNSHOT

34 / 86 (40%) from

FALLING FROM LOOKOUT

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Other firearm injuries:

- NOT hunting associated
- Includes paraphernalia shells, powder, etc.
- Includes cleaning, clearing, stowing, etc.
- Suspect suicide, homicide not included

		Frequency	Percent
	LOST WORKDAY	98	89.9
	FATAL	7	6.4
	PERMANENT PARTIAL	3	2.8
	PERMANENT TOTAL	1	.9
	Total	109	100.0

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Other firearm injuries:

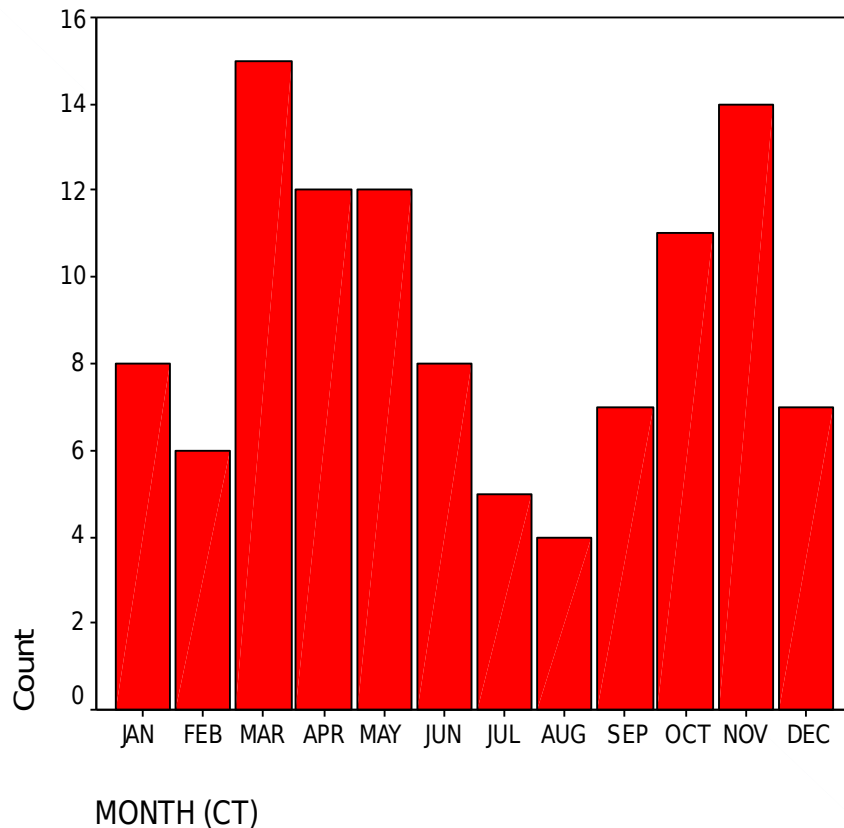
ACTIVITY		Frequency	Percent
	HANDLING GUN	26	23.9
	CLEANING GUN	17	15.6
	SHOOTING/TARGET PRACTICE/SKEET/TRAP	13	11.9
	LOADING OR CLEARING GUN	12	11.0
	DROPPED OR CATCHING GUN	8	7.3
	HANDLING AMMO, POWDER	6	5.5
	SHOWING GUN	4	3.7
	UNJAMMING GUN	3	2.8
	HOLSTERING GUN	3	2.8
	RETRIEVING GUN	3	2.8
	LOADED GUN IN GLOVEBOX DISCHARGES	2	1.8
	FISHING	2	1.8
	DISASSEMBLING GUN	2	1.8
	RICHOCHET	2	1.8
	STOWING GUN	2	1.8
	LIGHTING GUN POWDER WITH CIGARETTE	1	.9
	DISCHARGED FROM FRIEND'S POCKET	1	.9
	CAMPING	1	.9
	'DIDN'T KNOW IT WAS THERE'	1	.9
	Total	109	100.0



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Other firearm injuries:

- Somewhat seasonal
 - Bimodal
 - Fall hunting
 - Other?
- Inexperience, youth
- Carelessness



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Injuries by Firearms

Fatal Events:

- Cleaning gun & was shot in head when it discharged
- Fatally shot himself with a gun he thought was unloaded
- Shot in head when pistol he was handling discharged
- Placed handgun to head, pulled trigger & it discharged
- Handling gun when it accidentally discharged - fatal
- Accidentally shot self in chest w/.45 cal gun -



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Weight Lifting

INJURED PART (CT)

		Frequency	Percent
★	HEAD/NECK/SPINE/BACK	380	69.2
	ARM, FOREARM, ELBOW, SHOULDER	62	11.3
	INTERNAL & EXTERNAL CHEST, RIBS, GROIN, ABDOMEN	31	5.6
	FINGERS, THUMB, WRIST, HAND	30	5.5
	FOOT, ANKLE	20	3.6
	BUTTOCKS, HIPS, PELVIS, UPPER & LOWER LEG	11	2.0
	KNEE	8	1.5
	EAR, EYE, NOSE, JAW, MOUTH, TEETH, FACE	7	1.3
	Total	549	100.0

62% OF THE HEAD / NECK / SPINE INJURIES TO LOW BACK

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Purpose for DoD IOIPC

- Quantify
 - Sports & Rec to total unintentional injury
 - Rec - severity; ~ slightly less than comparative
 - Sports - incidence; less than comparative
 - 'Preventable'
 - Rec - behavior, risk, youth, inexperience, bike, pedestrian
 - Sports - small opportunity for 'prone' individuals?
 - Sports: risk-of-play associated
 - Opportunity where 'excess' exists (find out why)
 - 'Usual suspects' - age, sex, safety enforcement

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Purpose for DoD IOIPC

- Demonstrate (brief) power of safety data

- For purpose of injury epidemiology, prevention

It's a goldmine !!!

CDC is envious...

Population-based surveillance system

Nothing else like it in the world

Thank Safety and Services

communities

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Purpose for DoD IOIPC

- Introduce concept of modeling expectation
 - Risk management
 - Deployment
- Usefulness: is accepted risk of activity too high ?
- Logistics of medical resources
- 'Replacement' personnel

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Back Injury Events Among Air Force Personnel

11 Year Historical Study (1988 – 1998)
Military and Civilian Personnel

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Purpose for DoD IOIPC

- Back injury is common, costly, debilitating
 - DoD burden
 - Prevention challenge
- Awareness of project
- Secondary prevention opportunities

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Back injury: AF experience

- Purpose of AF project
 - Descriptive study (1988 – 98) civilian and military
 - Explore previously reported potential associations
 - Age, sex, tasks, activities
 - Explore potential association between lost workdays and military status
 - Explore potential association between day of week and on/off duty status

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Back injury: Methods

- Observational (N = 14,141 events)
 - Predictors of interest
 - Age, sex, military status, calendar year, day of week, on/off duty status, activities, injury type
 - Response variables of interest
 - Days of work lost
 - PMV mishaps excluded
- Data sources
 - AFSC, FECA (via DCPMS), Personnel centers

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Back injury: Results

- Risk estimates (AFSC data source):
 - On duty, civilians at greater risk than military:
 - $RR = 8.6$; 95% CI = 8.2, 9.0
 - Males at greater risk than females:
 - Military: $RR = 1.32$; 95% CI = 1.09, 1.59
 - Civilian: $RR = 1.29$; 95% CI = 1.13, 1.47

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Back injury: Results

- Risk estimates (AFSC data source):
 - Younger than 41 years of age at risk (vs. 41+ yrs):
 - Military: $RR = 1.41$; 95% CI = 1.20, 1.67
 - Civilian: $RR = 1.61$; 95% CI = 1.39, 1.85
 - Declining incidence; 1996 – 98 vs. prior years:
 - Military: 2.80; (2.62, 3.01)
 - Civilian: 1.83; (1.72, 1.96)

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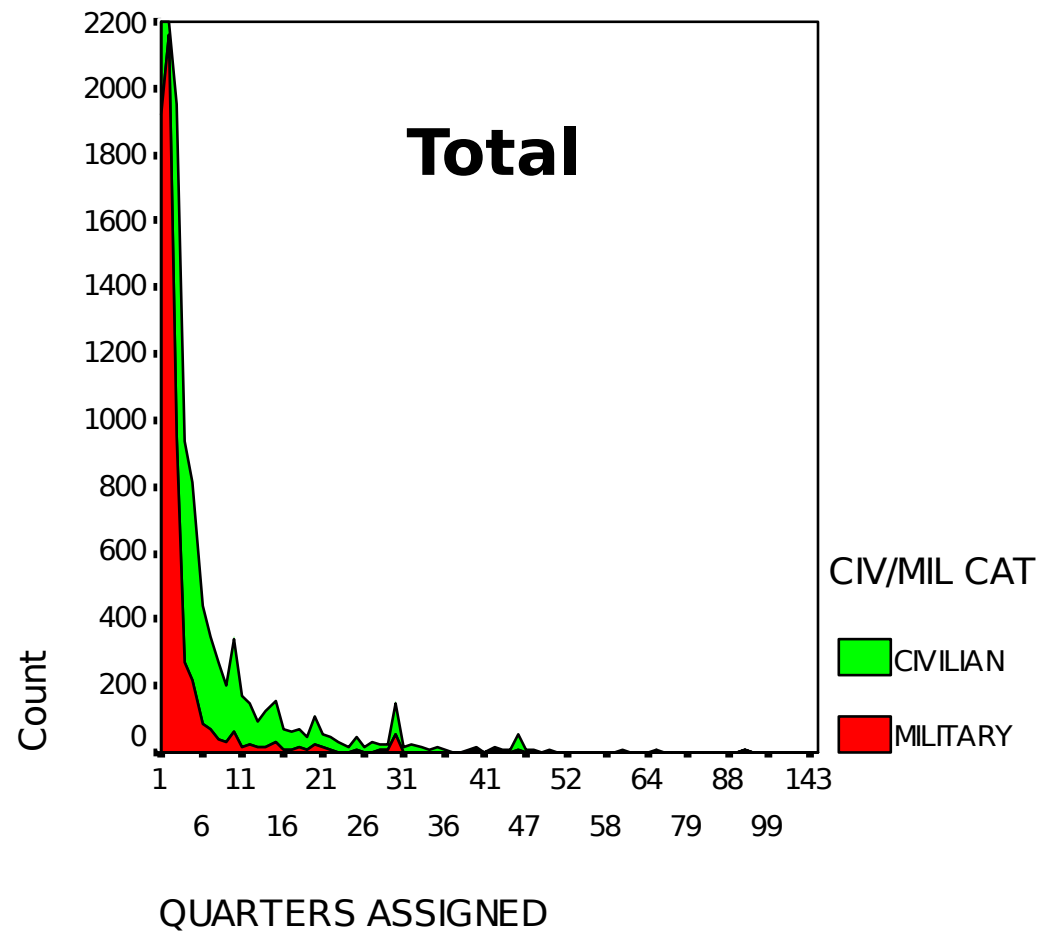
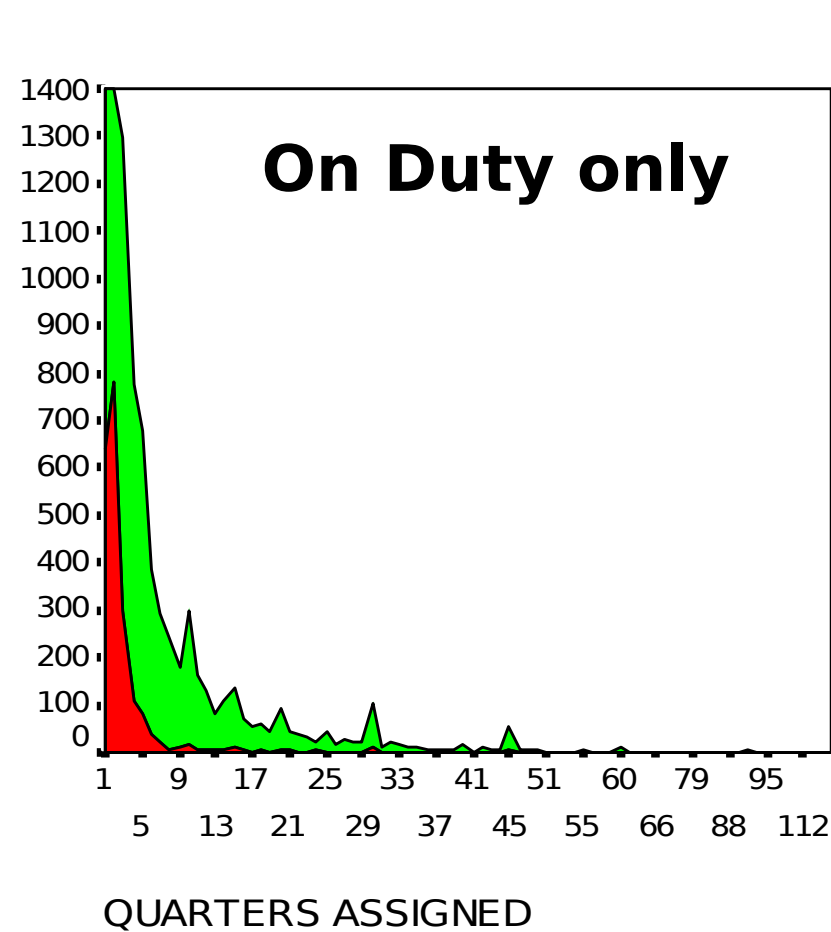
Back injury: Results

- Risk estimates (AFSC data source):
 - Among military, off-duty at risk (vs. on-duty):
 - Crude: 1.93; (1.84, 2.03)
 - 1996 – 98 stratum specific: 1.28; (1.13, 1.46)



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Back injury, lost workdays



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Back injury: Results

- Days of work lost:
 - Civilians lost over 4-fold more time
 - Crude estimate: 4.41; (4.15, 4.67)
 - Mean, median days off declined over time for both military and civilian personnel

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Back injury: Results

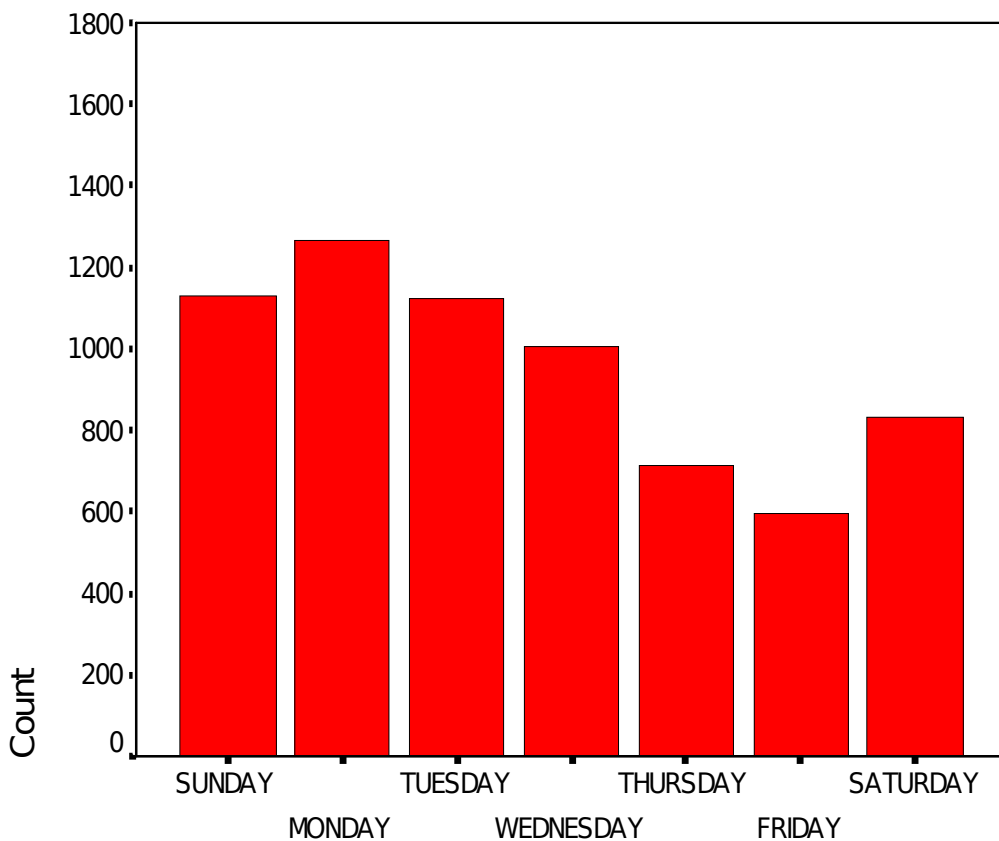
- Days of work lost:
 - Analysis of median days off
 - Stratum specific risks among non-hospitalized cases, calendar year-adjusted:
 - Among males < 41 yrs: 2.92 (2.68, 3.18)
 - Among females < 41 yrs: 2.36 (2.01, 2.75)
 - Among all 41+ yrs: 1.86 (1.57, 2.2)

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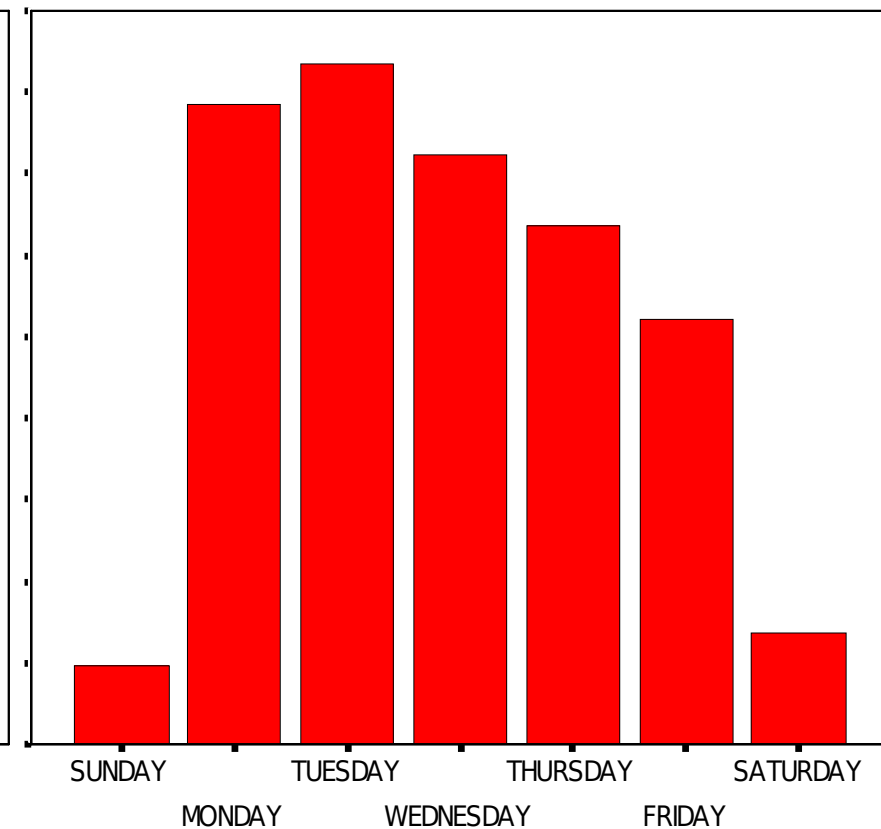


Day of Week Comparison

MILITARY - ALL CASES



CIVILIAN - ALL CASES



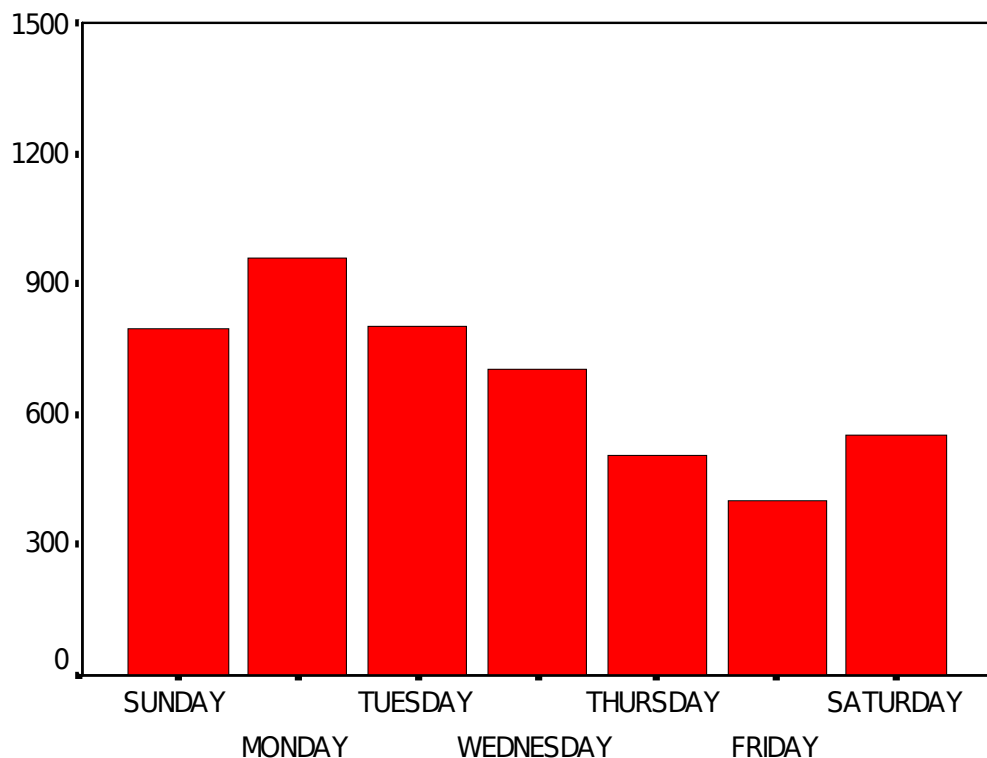
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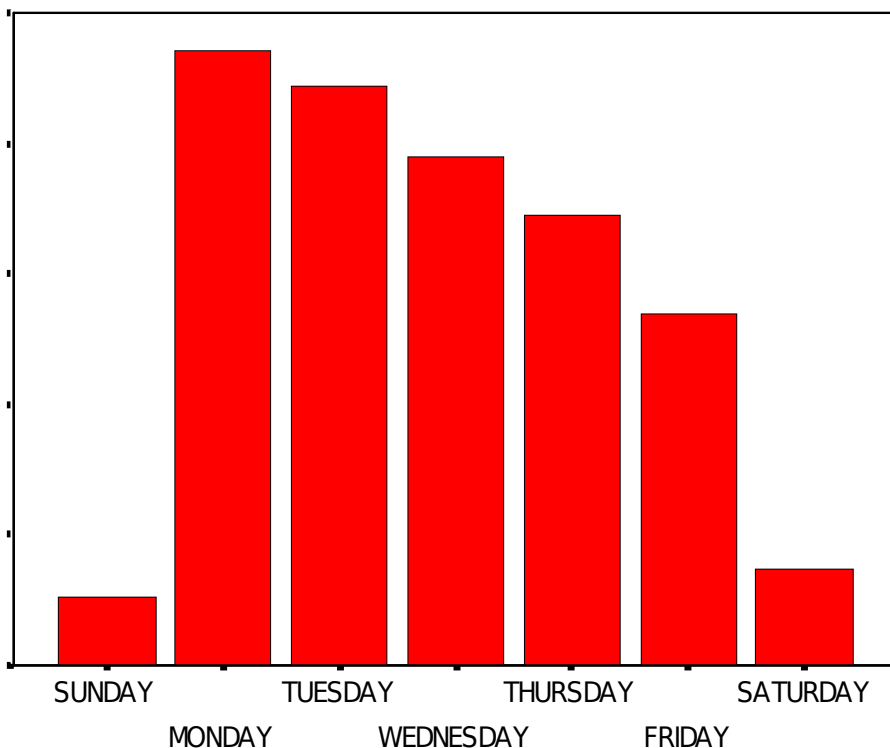
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Day of Week Comparison

MILITARY, NO HOLIDAY WEEKS



CIVILIAN, NO HOLIDAY WEEKS



DAY OF WEEK, NON-HOSPITALIZED CASES

DAY OF WEEK, NON-HOSPITALIZED CASES

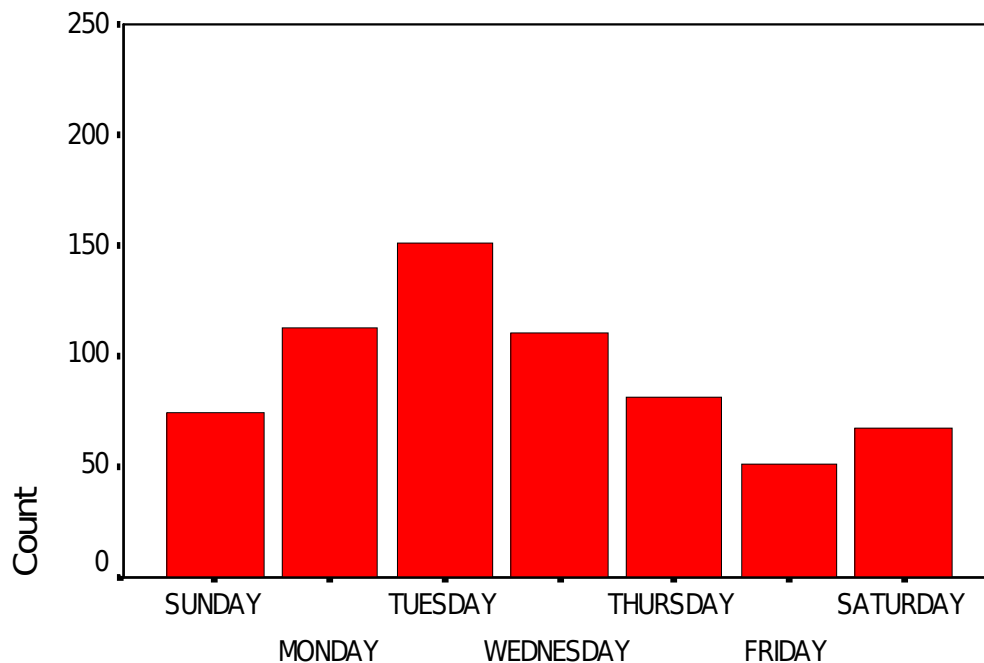
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Day of Week Comparison

MONDAY HOLIDAY WEEKS ONLY

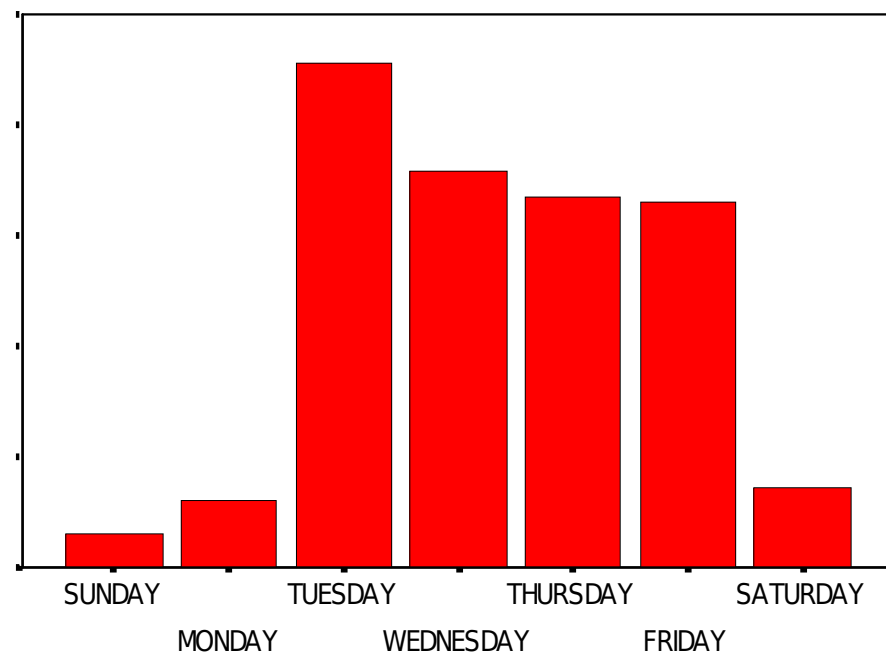
MILITARY, ON AND OFF DUTY



NON-HOSPITALIZED CASES

MONDAY HOLIDAY WEEKS ONLY

CIVILIAN, ON DUTY



NON-HOSPITALIZED CASES

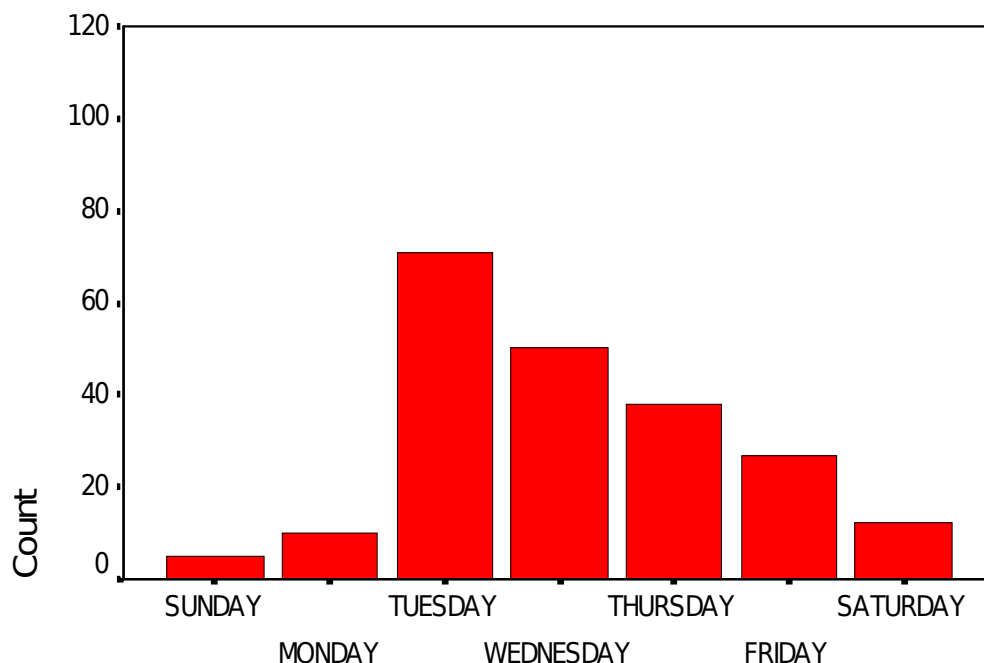
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Day of Week Comparison

MONDAY HOLIDAY WEEKS ONLY

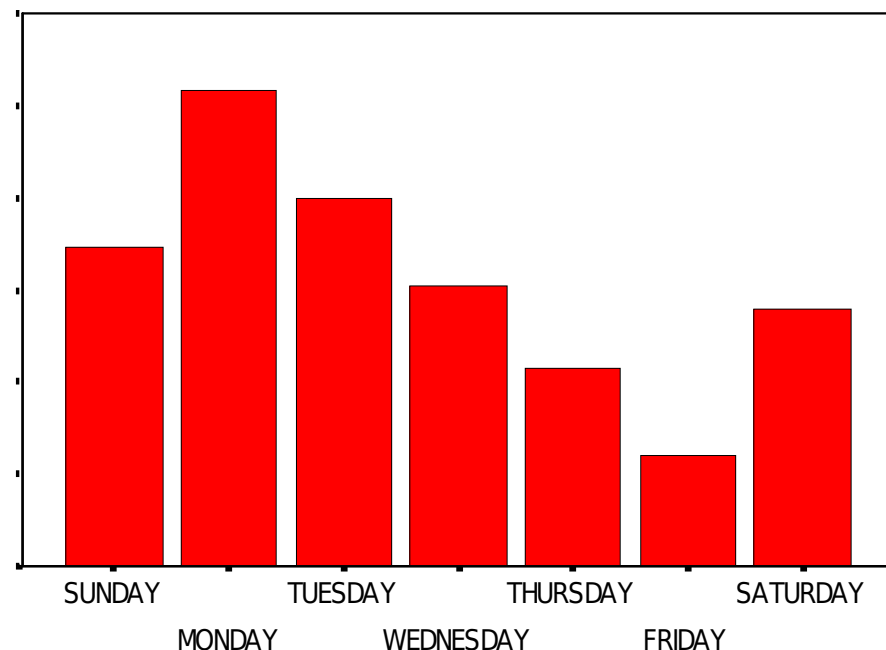
MILITARY, ON DUTY



NON-HOSPITALIZED CASES

MONDAY HOLIDAY WEEKS ONLY

MILITARY, OFF DUTY



NON-HOSPITALIZED CASES

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Back injury: Results

- Day of week distribution:
 - Fridays consistently low
 - Report bias (case definition)
 - Leave
 - Fewer 'big' projects ?
 - Wednesday consistently most 'normal' day
 - Natural history of backache: fits off-duty

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Back injury: Results

- Day of week distribution:
 - Post-holiday means
 - Mondays (following ‘no-holiday’ week)
 - Tuesdays (following Mon gov’t holiday)
 - ‘Friday-adjusted’ risk for post-holiday vs. other days of work week:
 - 1.61; (1.45, 1.78)

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Back injury: Results

- Activities (on- and off- duty):
 - Lift, carry, pull, push, bend over; +/- twist (boxes, furniture, children, computers, firewood, construction; cumulative)
 - Slip/trip/fall (icy, wet, just waxed, uneven, holes, food debris, toys, pets, 'no apparent reason')
 - Reach, reach for falling object (children, shelved items)
 - Falls from heights (ladders, stairs, stools, chairs)
 - Sports and Rec (weight lifting, all sports)
 - Decline in racquet sports, tackle football, volleyball, running
 - 'Unusual tasks' - subjective

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Back injury: Discussion

- Risk factors
 - Overuse: 'one exertion' less common than 'several' lesser
 - Common, multi-factorial, great psychosocial component
 - Loss of job (factory closure, BRAC)
- Primary prevention
 - Long-term incidence reduction is rare
 - Workplace interventions can't help non-work factors
 - Secular: prevention *is* in many places; prevalent awareness
- Secondary prevention
 - Greater opportunity for individual and employer

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FECA claims, 'back strain' NOI:

	#	1994	1995	1996	1997	1998	1999	Mean
		2373	2271	2142	2062	2030	2007	
OLD	\$	35.2	34.9	33.6	33.0	32.7		
	M	M	M	M	M	M		
NEW	X	14,844	15,362	15,702	16,025	16,099		
	cost							
Inc/1K	\$	1253	1185	1105	1145	1129	1019	
	M	M	M	M	M	M	M	1.23
	X	1211	1061	979	1066	1064	1073	1076
	cost							
		7.7	7.8	7.4	7.9	8.1	7.4	7.9

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FECA claims, 'back strain' NOI:

- AFSC vs. FECA data:
 - FECA counts ~ 3 times as many
 - Report bias by case definition?
 - Under-reporting?



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DoD FECA claims

- 1998 Top-Ten reference (attachment)
 - Sorted by total AF dollars per year
 - Average of 30% of cases on books are new
 - New cases are less than 6% of annual costs
 - Among all NOI codes, back injury – highest annual cost
- 1998 Facts: DoD paid \$174M for back strain
 - \$5.4M (3%) of total for 'new' (same year) cases
 - \$61M (35%) of total for claims created prior to 1977

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Back injury: Recommendations

- OWCP Study (AFSC is engaged for AF)
 - Identify opportunities for Case Management
 - Identify BRAC associated claims
 - Musculoskeletal (including back), 'Job Stress'
 - Potential DoD Interest (Joint)
- BRAC associated claims prevention process



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Back injury: References

- AFSC Technical Report (abstract attached)
 - Out for final peer review
 - Includes substantial literature review - reference
- References of interest (abstracts attached)
 - Berkowitz and colleagues, Mil Med 1999;164(6)412-8
 - Feuerstein and colleagues, JOEM 99, 41(12):1024-31
 - Shepherd and LaFleur, JOEM 1996, 38(7):681-8

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